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**PREFUZING M483 PROJECTILES**

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**MARCH 1983**



**US ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND  
LARGE CALIBER  
WEAPON SYSTEMS LABORATORY  
DOVER, NEW JERSEY**

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<p>Since the Division Support Weapon System (DSWS) will have a significantly higher rate of fire than the M109 self-propelled howitzer and there will be little, if any, opportunity for the crew to fuze projectiles, a study was made to determine where prefuzing M483 dual purpose, improved conventional munition projectiles could best be accomplished.</p> <p>Personnel at the M483 load, assemble, and pack (LAP) plants; U.S. Army Armament Materiel Readiness Command, Rock Island, IL; U.S. Army Field (cont)</p>												

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20. ABSTRACT (cont)

Artillery School, Ft. Sill, OK; U.S. Army Defense Ammunition Center and School, Savanna, IL, and many other organizations were contacted for information for this study. Consideration was given to the experience of the Navy with prefuzing projectiles and of the Army with 4.2-inch mortars and 105-mm projectiles. The problems of prefuzing in the field artillery ammunition supply vehicle (FAASV) were given special attention as a future companion to the DSWS.

LAP plant prefuzing of M483 projectiles is presently impractical; supply system prefuzing is expensive, and user (field artillery personnel) prefuzing--probably in the FAASV or other ammunition resupply vehicle--is the most practical.

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## ACKNOWLEDGMENT

The subject of prefuzing Army howitzer ammunition in general and the requirements of multi-option fuze artillery (MOFA) in particular were initiated by Donald R. Beeman of Beeman Associates, Inc. The author has drawn freely on those portions of Mr. Beeman's work which relate to this study.

## FOREWORD

Analysis of probable battlefield requirements for field artillery in the 1990's indicates an emphasis on rapid firepower capability to decrease the effect of numerical inferiority against an attack by a major enemy. The proposed Division Support Weapons System (DSWS) will include higher fire rates than have been used in the past. To assure there would be no degradation of this higher rate capability, the Project Manager for Cannon Artillery Weapons Systems funded a study to determine the best location for prefuzing the 155-mm M483 dual purpose round, an improved conventional munition. In this report, prefuzing is defined as installing the projectile fuze at any point before delivery to the howitzer.

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## INTRODUCTION

The M483 dual purpose (DP), improved conventional munitions (ICM) round is considered to be one of the major components of the Army Field Artillery arsenal of weapons. Usable in three presently fielded, 155-mm howitzers (the M114A2 towed howitzer, the M109 self-propelled howitzer (SPH), and the M198 towed howitzer), the M483 round gives the battlefield commander the option of denying an area to the enemy by attacking personnel and armor simultaneously. The effect on the newest enemy tanks may be minimal, but any lightly armored targets and personnel are subject to an incapacitating fire. When fielded, the multiple launch rocket system (MLRS) will augment this capability even further. The M509 DP ICM round is also being produced to give the 8-inch howitzers the same capability.

Since the majority of the 155-mm rounds expected to be fired against a major enemy will be M483 DP ICM rounds and since a time fuze has been used almost exclusively with this round, the concept of prefuzing the round was an obvious possibility.

The pros and cons of prefuzing an artillery round are numerous and tend to be nebulous unless a detailed analysis is made of the possible problems and advantages entailed. This report documents such a study conducted between November 1981 and June 1982.

Extensive discussions were held with representatives of numerous organizations associated with this prefuzing consideration. The opinions and advice of these experts are reflected in the findings reported herein. In addition to personnel of Large Caliber Weapons Systems Laboratory, ARRADCOM, the following organizations participated in this study:

U.S. Army Armament Materiel Readiness Command, Rock Island, IL

U.S. Army Armament Materiel Readiness Command Detachment, Dover, NJ

U.S. Army Defense Ammunition Center and School, Savanna, IL

U.S. Army Field Artillery School, Ft. Sill, OK

U.S. Army Infantry School, Ft. Benning, GA

U.S. Army Logistics Center, Ft. Lee, VA

U.S. Army Missile and Munitions Center and School, Redstone Arsenal, AL

U.S. Army Tank-Automotive Command, Warren, MI

U.S. Army Test and Evaluation Command, Aberdeen, MD

U.S. Marine Corps Liaison Office, ARRADCOM, Dover, NJ



Naval Weapons Support Center, Crane, IN

Naval Surface Weapons Center, White Oak, Silver Spring, MD

DARCOM Field Safety Activity, Charlestown, IN

Crane Army Ammunition Activity, Crane, IN

Kansas Army Ammunition Plant, Parsons, KS

Lone Star Army Ammunition Plant, Texarkana, TX

Mississippi Army Ammunition Plant, Picayune, MS

Project Manager for Cannon Artillery Weapons Systems, Dover, NJ.

#### RECENT PREFUZING OF LARGE CALIBER AMMUNITION

##### Army Howitzer Ammunition

Prefuzing large caliber ammunition is not unknown in the Army. Recently, 105-mm ammunition has been prefuzed during manufacture. Also, because 105-mm is a cased round (i.e., has the propellant in a case attached to the projectile), it lends itself to prefuzing, thereby eliminating the need for any auxiliary parts. Load, assemble, and pack (LAP) procedures and methods had to be modified and carefully monitored to permit safe assembly and handling of the combined fuze and round combination following a tragic accident at Lone Star Army Ammunition Plant that resulted from unauthorized spinning of the fuze. After this correction, no problem was encountered with production, shipping, handling, or storage of the prefuzed 105-mm rounds.

Not all 105-mm rounds were or are prefuzed. The user has several fuze options available for high explosive (HE) or white phosphorous (WP) rounds. A minimal handling problem is encountered with a 105-mm round because of its weight (less than 22 kg) and small diameter, allowing lifting by hand from any direction. The standard packaging for 105-mm fused rounds also physically protects the round and fuze from damage, but does not seal out moisture. The U.S. Army Materiel Systems Analysis Activity (AMSAA) has determined that the assembled shelf life of one type of 105-mm round is only half that of separate components due to moisture degradation of the explosive train of the fuze. If prefuzed rounds were to be produced, this might not be a problem since the seals on fuzes have been improved.

##### 4.2-Inch Mortar Ammunition

Prefuzing the 4.2-inch mortar ammunition should be considered as the round uses the same fuzes as Army large caliber howitzer ammunition. The Marines also

use the 4.2-inch mortar and follow the Army doctrine. The last Marine buy was LAP-prefuzed with the M557 PD fuze. Recent Army buys were prefuzed (except for the M335A2 illuminating round with M577 MT fuzes), but rounds have been prefuzed in the past. Since there are numerous types of 4.2-inch mortar rounds available that require different fuzes, the Infantry (as the user) is interested in LAP-prefuzed ammunition to simplify their logistics. Their doctrine requires fuzing in the M106 mortar carrier after it has been stopped to prepare for a mission. When the rounds are received from the ammunition resupply vehicle (ARV), they are removed from the wooden packing crates and protecting cardboard tubes, fuzed (if not prefuzed), replaced in the cardboard tubes for protection, and stored in the ready racks of the M106. The M106 can then be moved into position for its mission (if it is not already there). The ARV at this time is usually a truck, the crew of which does not have the military operational specialty (MOS) to prefuze the rounds. Although a more dedicated ARV is under consideration, it would probably not be specialized enough for the crew to prefuze the 4.2-inch mortar rounds. Handling the mortar rounds (12.7 kg) is no problem, and the packaging affords protection, with or without a fuze.

#### Navy Large Caliber Ammunition

The Navy currently maintains three classes of ammunition for their shipboard guns: fixed, separated, and bagged gun (fig. 1).

Fixed ammunition (fig. 2) applies to ammunition which has the cartridge case crimped around the base of the projectile. The primer is inserted into the cartridge case. The projectile and the cartridge case containing the primer and propelling charge form one unit as a fixed round of ammunition. Small caliber guns and guns through 3 inch and 76 mm use fixed ammunition.

Separated (cased) ammunition applies to larger ammunition and consists of two parts, the projectile assembly and the cartridge case assembly (fig. 3). The projectile assembly consists of the projectile body containing the payload or explosive and nose fuze or base fuze, as applicable. The cartridge case assembly is similar to the fixed ammunition round, except the projectile is replaced with a mouth plug (to close the open end of the cartridge case). In older ammunition, the mouth plug was cork, but in newer ammunition it is plastic. Both are chambered and consumed in the firing process. Whereas in fixed ammunition the cartridge is crimped to the projectile on or aft of the rotating band, in separated ammunition it is crimped on the mouth plug. The term "cartridge" in the Navy usually means a complete round of fixed ammunition. Separated ammunition is produced for 5-inch, 38-caliber through 8-inch, 55-caliber guns.

Bagged gun (separate loading) ammunition applies to all gun sizes larger than 8 inches and one 8-inch gun type still in use. The older cruisers use the separate loading, bag-type ammunition while the newer classes of heavy cruisers use ammunition of the separated type. These two types of ammunition are generally referred to as 8-inch slow fire (SF) for the older bag type and rapid fire (RF) for the new separated types.

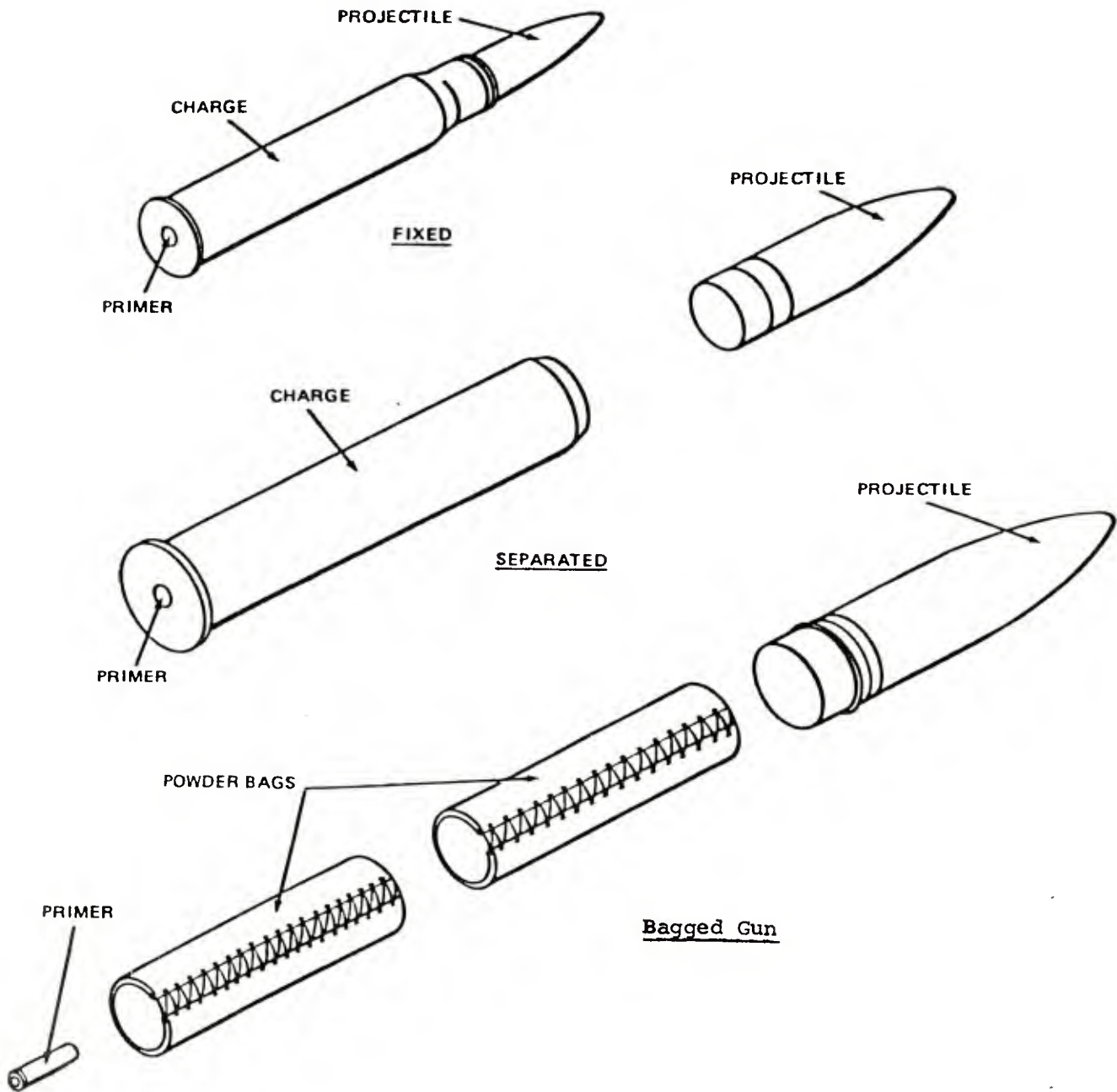


Figure 1. Types of Navy shipboard gun ammunition

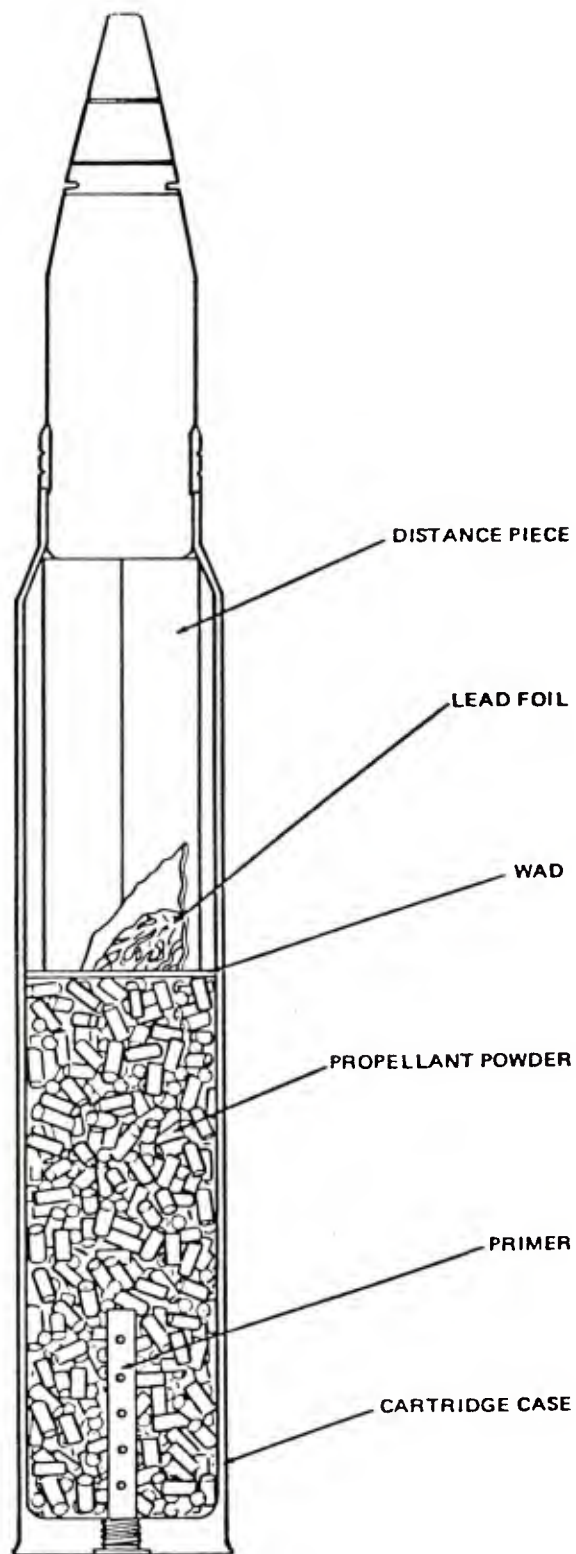


Figure 2. Components of the propelling charge in Navy (fixed) ammunition

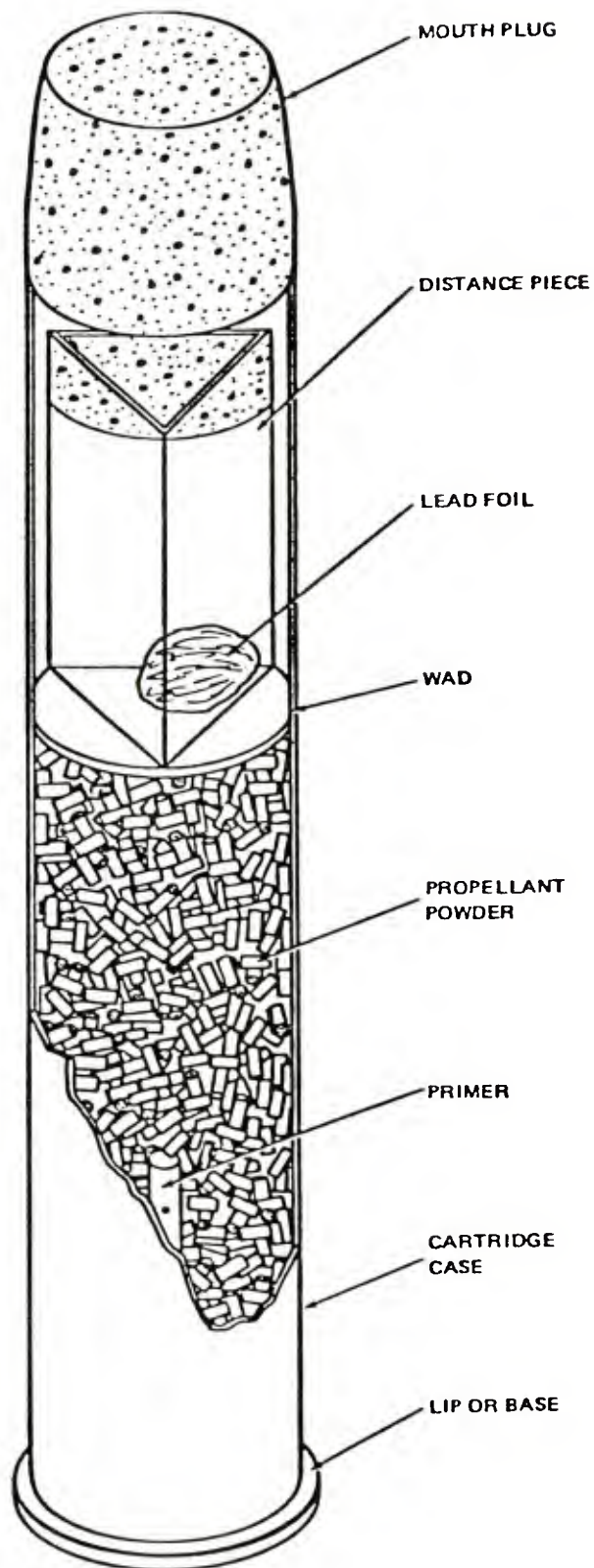


Figure 3. Components of the propelling charge in Navy separated ammunition



The Navy prefuzes all their current large caliber ammunition projectiles at time of manufacture or at the CONUS depot. Luting (MS603), a paraffin-based compound, is heated to the liquid state and applied to the fuze threads, and the fuze is then torqued to the projectile. This gives a sealing and a small amount of adhesive action between fuze and projectile. Additionally, some fuzes are then staked to the projectile. Each nose fuze on the separated or bagged gun projectile is covered with a metal fuze cover to protect the fuze after it is in place. The fuze covers are of two designs: the older design is secured using threads on the projectile ogive; and a new design (fig. 4) uses a large circlip and a groove on the ogive for attachment. The new design is sealed with an "o" ring. The Navy is not completely satisfied with the storage of their rounds where fuzes are concerned. Under some conditions, the fuze cover is believed to seal in the moisture, and has been redesigned partly to correct this condition with a better seal, and partly to enable the cover to be removed more rapidly by just yanking off the circlip with a hooklike tool. Although the new design cover has only been applied for a short time on one round, it has been very well received. While its eventual use on all large projectiles is expected, it has not been in use long enough to determine the efficacy of the seal to eliminate the moisture problem. The rounds are stored vertically in steel pallets which have integral lifting eyes. The pallets are either lowered with dock cranes directly into the ship's hold, or off-loaded onto the vessel's elevators and lowered to the magazine. In some cases neither method is possible and the rounds must be off-loaded topside and slung two decks to the magazine. Here they are stored vertically in racks along the walls along with the various charges.

With the 5-inch, 54-caliber guns and rounds (the most widely used active Navy system), the separated cartridge case assembly and the projectile assembly are hand-loaded vertically into a two-layer drum (20 rounds maximum capacity) with the projectile assembly on top and the cartridge case assembly below, configured in firing position. The fuze cover is removed either before or during the drum-loading operation. Hand-loading can be accomplished without undue fatigue since the projectile assembly is approximately 32 kg; the cartridge case assembly is approximately 16 kg; and a mixed 20 rounds can be preloaded as a cushion. The drum can then be reloaded between firings. By being indexed to the desired point, the two parts of the round are aligned to be mechanically hoisted up two levels to the gun mount, still in chambering position. They are then chambered by a mechanical loader. The projectile assembly is stopped by the lands, and the cartridge assembly by the cartridge case lip (fig. 3). This leaves space between the mouth plug and the projectile base that becomes the source of the "shock start" requirement for Navy fuzes. Different ranges are accommodated by using three cartridge case assemblies with three different amounts of propellant.

#### M483 PREFUZING

The pros and cons of installing the projectile fuze at any point prior to delivery to the howitzer are detailed in the following section.

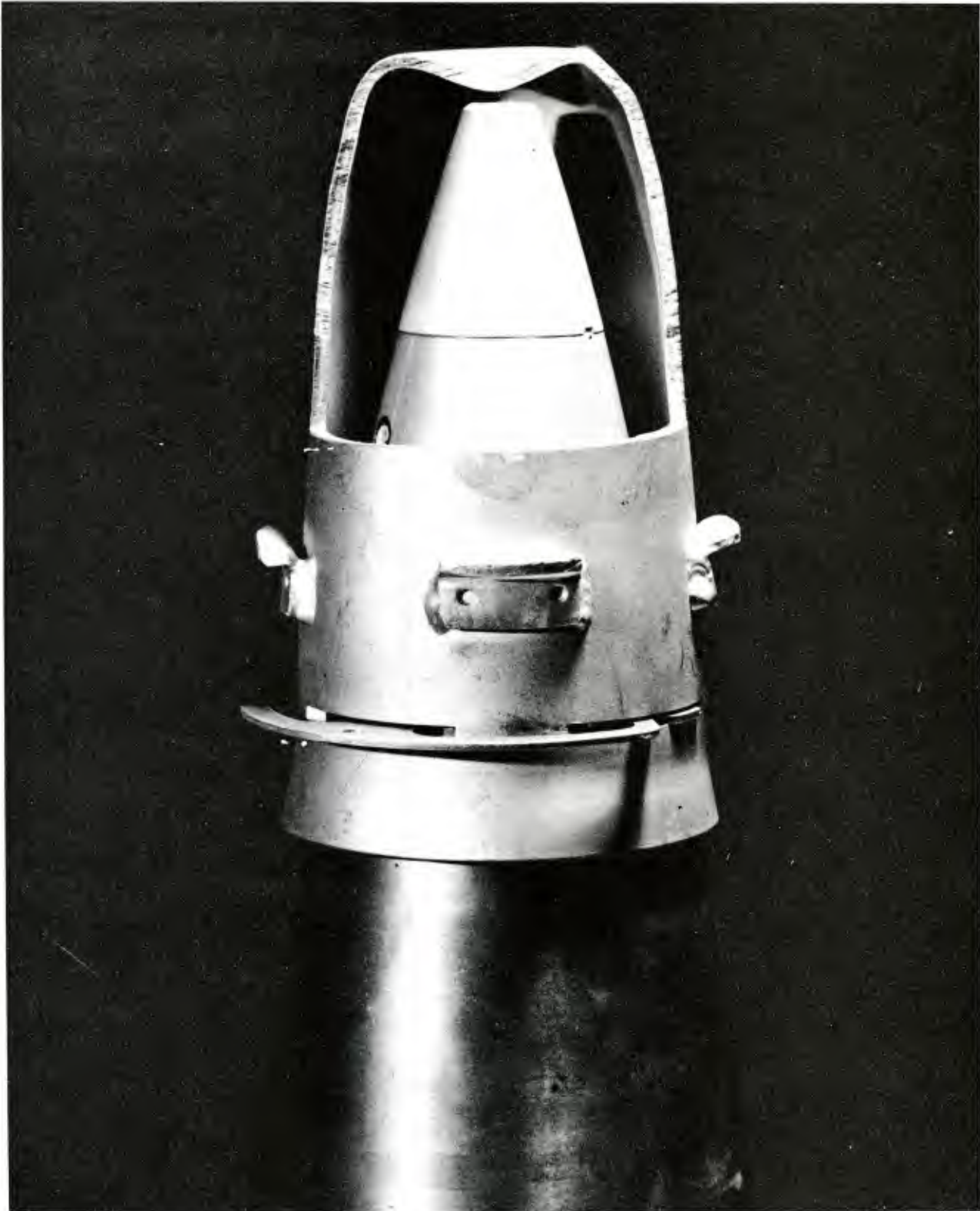


Figure 4. Cutaway view of Navy fuze cover with circlip

## Load, Assemble, and Pack Plant

Prefuzing projectiles at the LAP plant is an obvious possibility. However, the advantages and disadvantages polarized the cognizant personnel more than any other prefuzing possibility. Prefuzing at the LAP plant would require changes to projectile assembly lines and to handling of the completed round. Fuze protection would also be required. Based on the Navy's experience with fuze protection, a steel cap would have to be used and a method of attaching this cap to the projectile would have to be devised. It poses two problems however: would grooves or threads on the projectile ogive cause ballistic problems and how would the round be moved without a lifting plug? One solution would be to combine the fuze cover and lifting plug; i.e., put a lifting loop on top of the fuze cover. The lifting loop and fuze cover would need to be strong enough to support the weight of at least two rounds for the use of a "four-legged sling" on an eight-round pallet. This would then pose two additional problems: would the groove or threads be strong enough to lift the projectile (45 kg) and where would the fusible feature, presently included in the lifting plug, be placed? (ARRCOM would not accept an ICM cargo round that did not include protection against cargo expulsion by fire.)

Solving the problem of the fusible lifting plug replacement is of paramount importance. The current design plug used with the M483 and M509 rounds has a fusible alloy filler approximately 2.5 cm in diameter and 0.9 cm thick. When subjected to high temperatures, the filler melts and provides a hole through which the cargo expulsion charge pressure escapes. In reality, the pressure is enough to cause cargo expulsion, but on a much more limited basis than if no fusible feature were provided.\* If this fusible feature is to be available, it will have to be provided in the ogive area of the projectile itself. Venting, superior to the existing lifting plug, could be obtained with two 2.5 cm holes opposite each other in the ogive, and balancing each other when filled with fusible material. If made with a "V" contour, the plugs should resist the centrifugal force caused by the projectile spin. However, consultations with the personnel responsible for the design and modification of the metal parts of the M483 projectile (and the M509) revealed that the pressure during expulsion (10,000 psi) would be more than the fusible metal could withstand (app A). This results in an apparent enigma as there is no space large enough to vent through the fuze.

The method of handling the completed fuzed rounds is of major importance. Presently, the lifting plug provides an almost ideal way of moving the round with a mechanical hoist. If the plug is not used for lifting, an alternate method of handling will have to be provided. If a horizontal packout method were used [considered a method of handling to use the Field Artillery Ammunition Support Vehicle (FAASV) racks], the packing would have to be done with a special machine.

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\* Samuel Davelman and Willis H. Taylor, "Modification of Standard Lifting and Closure Plugs to Fusible Plugs for Improved and Certain Conventional Munition Projectiles," PA Technical Report 4103, Picatinny Arsenal, Dover, NJ, June 1970.



The FAASV horizontal racks are estimated to cost \$200 minimum, while the present vertical pallets are about \$10 each. A more desirable option would be to retain the vertical packaging (eight to a pallet), adapted to a fuze cover with an integral lifting loop. All the present handling methods and equipment would be applicable, but the quantities that could be stored or moved in a given space might decrease because of the increased palletized height of the eight rounds. This would be counteracted by the space saved by not having separately packaged fuzes. There should be no effect on the storage compatibility or safe separation distance. Amortized LAP plant costs were estimated by LAP contractor personnel to be up to \$2.15 per round. If LAP prefuzing were used, the capability to produce projectiles without the fuze would have to be maintained in at least one of the LAP plants to have the option when required. This might be required for self-registration (spotting) rounds if a satisfactory method to insure that the fuze cannot loosen during shipping results in a non-removable fuze, or one that can only be removed under special conditions set up at a depot.

Another problem, extant in M483 production, could adversely affect LAP plant prefuzing, since it would result in unknown storage life with the fuze in place. Since AMSAA surveillance has shown that fuze life in 105-mm ammunition is adversely affected by LAP plant prefuzing, the M483 round may encounter a similar problem. Cyclohexanone migration from the composition A-5 grenade explosive into the RDX lead is suspected of being the cause of problems with the M42 grenade. The cyclohexanone might similarly affect the lead in the M577 projectile fuze. Although this is considered a remote possibility, it is one that should not be ignored and would need a thorough investigation.

A minor consideration would be the problem of removing field-rejected or suspended fuze lots from the rounds. If the fuzes are staked or locked in place, the force required for removal could be excessive. The process would also be labor-intensive and, therefore, expensive.

#### Depots

Consideration of prefuzing in depots is presently restricted to OCONUS since no appreciable stockpile of M483 projectiles exists in CONUS. However, following an anticipated buildup of M483 stockpiles in CONUS, large-scale prefuzing could be accomplished in either OCONUS or CONUS depots. The expertise, manpower, machinery, and handling equipment are already available in CONUS and OCONUS depots, but an added expense would be encountered when the prefuzing operation is employed. Protecting the fuzes in subsequent supply activities would still need to be accomplished as well as providing a method for moving them. The ammunition is still under the jurisdiction of the supplying organization (ARRCOM).

#### Ammunition Supply Point

The timely distribution to the user of the quantities of ammunition needed in a war has evolved an extensive field system which is only simplistically described here. In a large theater of operations, there will be a rear ammuni-

tion supply point (ASP) or corps storage area where the ammunition from the depot is first received (in large trucks or even from a railroad). It is then usually transferred to smaller trucks and moved to a forward ASP where it is held and/or transferred to trucks which go to the ammunition transfer point (ATP).

The forward ASP may receive containerized shipments directly and break them up for transfer to the ATP. It therefore represents the first point at which the user (or his supplying personnel) could prefuze projectiles. However, the M483 projectiles would still be palletized. Since the ASP is in a forward position, facilities would be minimal, typically a concealed area with the emphasis placed on loading, unloading, and moving trucks through quickly and not on performing any maintenance or servicing of the projectiles. Night operations with minimal lighting are to be expected.

The rear and forward ASPs may be combined if required and/or the forward ASP may combine with the ATP in some smaller theaters of operations. The supply requirements, tactics, and physical features will determine the configuration chosen.

#### Ammunition Transfer Point

Ammunition transfer point prefuzing would present several difficulties. The operational requirements at the ATP might not allow sufficient extra time for personnel to prefuze all ammunition. Resupply and rapid ammunition transfer are the major considerations at the ATP. Fuzed rounds would still need fuze protection when placed in the ammunition resupply vehicle (ARV) and also a method of handling since the lifting plug would be removed for fuzing.

#### Ammunition Resupply Vehicle

Ammunition resupply vehicle prefuzing for the M483 projectile requires careful consideration. Since any suitable vehicle may be used as an ARV, some qualifications should be made at this point.

The user will solve his ammunition resupply problems in the manner most advantageous at the time. Shortages of some vehicles, poor ATP locations, proximity of ASPs, terrain, and weather are examples of factors which can affect the resupply system. The present ARV for normal situations is an M548. It is a tracked vehicle with no crew protection (except against weather) in which the rounds are manhandled in and out and are placed vertically on their bases. It is a dedicated ammunition transporting vehicle, and is crewed by a driver and ammunition handlers qualified to fuze projectiles. Trucks are also used as ARVs in special situations.

The ARV of the near future appears to be the FAASV (XM992 field artillery ammunition support vehicle) which has completed DT-II tests at Yuma and OT-II tests at Ft. Still. It is a tracked vehicle that is identical in motor and drive to the M109 self-propelled howitzer (SPH) and different only above the deck

level. It has similar personnel protection to the M109 SPH and is equipped with a conveyor to move single 155-mm or 8-inch projectiles in or out for loading or dispensing to the M109 SPH or M110 SPH. There are removable racks for 8-inch or 155-mm projectiles which are used in conjunction with the conveyor and an X-Y stacker to store the projectile horizontally without any manual lifting. When needed, the projectiles are retrieved in the same manner. The conveyor is inserted into the M109 SPH and the 155-mm projectiles are delivered mechanically instead of manually. The same situation is expected in the Division Support Weapons System (DSWS).

Since the 155-mm and 8-inch projectiles are often prefuzed in the ARV, the user tested the FAASV with this in mind. It was found that prefuzing could be accomplished in four places in the FAASV. The first location would be in the racks. If the locking devices in racks are applied to the rounds individually, the 155-mm rounds can be fuzed in the racks when the FAASV is not moving. The lock is released, the round is pulled out partially with the lifting plug, the lifting plug is removed, the fuze is inserted and tightened with an M18 fuze wrench (typically), and the round is pushed back into place in the rack and locked. As needed, the lock is released so the projectile can be removed by a lever built into the rack which hooks the base plug and pulls the projectile onto the X-Y stacker tray. The same procedure would be followed with the 8-inch round since the system will give enough force to slide the round onto the X-Y stacker tray, even if the FAASV is tilted forward.

The situation changes if all the projectiles in the rack are locked at once. It would no longer be safe to release the lock except when the FAASV is stopped. Then the fuzing would have to be accomplished without withdrawing the round from the rack. Since the rounds extend a considerable distance from the rack, this would not be a major problem if a special fuze wrench is devised that will either swing into the available space or angle out to clear the adjacent rounds. This would replace the M18 wrench.

Drop testing by TECOM of 155-mm and 8-inch projectiles with fuzes attached resulted in fuze detonator functions in M564 and M577 fuzes with fragmentation in the nose down attitude. Until the extent of the hazard associated with this problem is fully determined, TECOM will not concur in a decision to transport fuzed rounds. Under these conditions, PD fuze detonators would be expected to initiate. The degree of hazard has not been determined but, may prove to be acceptable in the future if proper precautions, such as shielding, are taken. Until the potential hazard to the FAASV crew is more thoroughly evaluated, TACOM has stipulated that prefuzing not be done in the FAASV racks (app B).

The user also found it feasible to prefuze the 155-mm and 8-inch rounds on the X-Y stacker tray, on the "dead" section of the conveyor, and on the conveyor itself (when not running). These locations would not require any tools, but would reduce the sustained rate of fire of the DSWS if no "cushion" could be utilized. Prefuzing while transferring the rounds to the howitzer could keep up with the four-rounds-a-minute rate now permitted for the M109A2 SPH for the first 3 minutes of sustained fire. The FAASV OT-II tests at Ft. Sill indicate this to be the maximum expected rate to be sustained by a trained crew.

The capability of the FAASV ammunition handlers to prefuze while transferring projectiles to the howitzer at a rate of use in "shoot and scoot" situations or with the DSWS maximum fire rate (projected at 10 rounds per minute) seems feasible at this time. Chamber heating will restrict sustained fire rates to where using the racks of the automatic loaders of the DSWS concepts to provide a "cushion" will allow such a rate of fire (within the constraints of the weapon).

Prefuzing in the M548 ARV can be easily accomplished at the rates that the projectiles can be manhandled to the howitzer, and a "cushion" can be accumulated, if required.

## CONCLUSIONS

Prefuzing the M483 round in the load, assemble, and pack (LAP) plant would require several changes to, or logistic modifications of, the system using the vertical pallets. (Horizontal racks ready to go into the field artillery ammunition support vehicle would be excessively expensive to use throughout the supply system and, therefore, unacceptable.)

1. Extensively changing the LAP plant assembly line.
2. Adding a fuze cover with a lifting device.
3. Determining the ballistic effect of the fuze cover attachment.
4. Marrying the round production to the fuze production.
5. Finding a vibration-proof way to secure the fuze to the round so that the fuze can still be safely removed.
6. Determining the effect of long-term assembled storage of each fuze used in the M483 round.
7. Developing an acceptable method for providing venting for the M483 projectile that would be both fusible and integral to the expulsion cavity. [One method to accomplish this has proved to be unacceptable (app A)]. A dedicated engineering effort would be required to develop this method of venting. There is no assurance that this could be accomplished.
8. Modifying the pallets to accept rounds with fuze covers.
9. Redetermining the shipping configuration by truck, rail, ship, and air.
10. Developing a method of handling field rejected or suspended fuze lots to avoid tying up needed M483 projectiles.

Prefuzing in the depots does not warrant consideration since it would encompass virtually all the problems involved with LAP plant prefuzing and, in addition, would require each round to be rehandled and broken out of the present



shipping pallets. No advantage can be seen except that of usually avoiding the problem of rejected or suspended fuze lots.

Prefuzing at the ammunition supply point, ammunition transfer point, or in the ammunition resupply vehicle is really up to the user. Since he often prefuzes now in the ammunition resupply vehicle (ARV) and expects to in the field artillery ammunition support vehicle (FAASV) there is no reason for change. He is also going to adapt to the extant situation. There are minimal or no extra costs involved in prefuzing in the ARV, and this will remain as adaptable to fuze or doctrine changes as possible. It should be realized, however, that user prefuzing may eventually limit howitzer fire rates if prohibited in the FAASV racks. At that time, a method (based on experience with the vehicle and considering the trade-off factors of risk) may be developed to allow prefuzing in the FAASV racks. If not, LAP prefuzing may become a necessity even if it is not practical now or in the near future. Proposed methods to deal with the listed problems should be formulated now for future development.

#### RECOMMENDATIONS

It is recommended that prefuzing the M483 be done by the user, with the expectation that he normally does it in the ammunition resupply vehicle. It is expected that the field artillery ammunition support vehicle developers will support this position and enhance the user's capability to prefuze in this vehicle (but not in the racks).

It is also recommended that the M483 developer be requested to determine if there is an alternate method for limiting grenade expulsion during a fire that would allow load, assemble, and pack prefuzing.

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APPENDIX A

DISPOSITION FORM REGARDING M483A1 OGIVE MOD  
AS SUBSTITUTE FOR FUSIBLE LIFTING PLUG

# DISPOSITION FORM

For use of this form, see AR 340-15; the proponent agency is TAGO.

REFERENCE OR OFFICE SYMBOL

DRDAR-LCU-M

SUBJECT

M483A1 Ogive MOD as Substitute for Fusible Lifting Plug

TO

DRDAR-LCN-T  
ATTN: E. Roller

FROM

DRDAR-LCU-M

DATE

JUL 1 1982

CMT 1

D. Robertson/cmk/3482

1. In response to your fonecon, this office has considered the possibility of adding a fusible element to the M483A1 type ogive. This design would be utilized when the stocked, stored and issued projectile is in the fused configuration. As discussed, two one inch diameter pressure relief holes, filled with low melting temperature metal, would be required to replace and/or improve the performance of the current fusible element lifting plug.

2. Mr. Carl Larson, DRDAR-LCA-M, has reviewed the stress analysis of the M483A1 ogive and determined that the component had sufficient strength to perform with the above-described holes located near the nose threads. The strength of the low melting temperature metal was projected to be 2000 psi tensile, 1000 psi shear. Based on this strength, it is Mr. Larson's opinion that the meltable disk would not withstand the pressure sustained in the ogive cavity during the expulsion phase of the ballistic environment, approx. 10K psi.

3. Therefore, it is opinion of this office that the proposed ogive modification is not feasible. This opinion is based on the above without detailed evaluations of the other design considerations of the concept; i.e., joint design, protective finish considerations, galvanic susceptibility and atmospheric pressure sealing.

JAMES J. WALSH

Act'g C, Mun Metal Parts Engr Br



APPENDIX B

TACOM LETTER REGARDING PREFUZING M483 PROJECTILES



**DEPARTMENT OF THE ARMY**  
**US ARMY TANK-AUTOMOTIVE ~~MAINTENANCE~~ COMMAND**  
**WARREN, MICHIGAN 48090**

DRSTA-CZ

15 October 1982

SUBJECT: Prefuzing M483 Projectiles

Commander  
US Army Armament Research & Development Cmd  
ATTN: DRDAR-LCN-T  
Dover, NJ 07801

1. The draft report concerning prefuzing M483 projectiles has been reviewed as requested. The following comments are provided regarding the recommendation to fuze projectiles in the FAASV or other ammunition resupply vehicle, ARV.
2. The primary TACOM safety interest in this draft report concerns the recommendation to fuze projectiles in the ARV and more specifically, the FAASV. The report acknowledges the potential hazards associated with fuzing projectiles in the LAP Plant, Depots, ASPs, and ATPs and recommends fuze protection to prevent both fuze damage and possible detonation due to rough projectile handling. Hazards associated with rough projectile handling also exist in the ammunition resupply vehicle, yet there is no recommended control action addressing this hazard.
3. The following FAASV design features allow projectiles to be fuzed in the projectile racks, on the stacker tray or on the conveyor dead section: Projectile locks are designed to secure both fuzed and unfuzed rounds. A system is being developed to allow easy projectile removal from the projectile racks when fuzed or unfuzed; and ammunition handling equipment such as the stacker and conveyor can adequately transfer both fuzed and unfuzed projectiles. While the FAASV design allows prefuzing of projectiles, this practice presents added risk to the vehicle crew.
4. TECOM has conducted fuzed projectile drop tests to determine the safety risks associated with transporting fuzed projectiles in the FAASV. Various projectile/fuze combinations were dropped from a height of 7 feet to simulate the maximum stowage height of the FAASV ammo racks. Projectiles were dropped in four different orientations with the fuze down attitude being the worst case. The stab charge of the M564 fuze was found to detonate with resulting shrapnel when dropped nose down with both 155 mm and 8 inch projectiles. It was therefore, concluded by TECOM that fuzed projectiles could not be safely transported in the FAASV.

DRSTA-CZ

15 October 1982

SUBJECT: Prefuzing M483 Projectiles

5. This office does not oppose fuzing projectiles in the FAASV provided they are fuzed on the stacker tray or conveyor dead section and then, only when needed. This office, however, supports TECOMs position concerning the transport of fuzed ammunition in the FAASV.

6. The risk associated with fuzed artillery projectiles is presently minimized by fuzing projectiles only when needed. Any change to this practice will undoubtedly increase the risk associated with artillery projectile handling operations. Before any recommendation is made concerning prefuzing projectiles in the racks of the FAASV, it is recommended that the hazards associated with this practice be more thoroughly evaluated. Based on the TECOM drop test results, it appears that the potential hazard to the FAASV crew would be significantly increased if fuzed ammunition was allowed to be transported and handled in the FAASV. The Army must decide whether this added risk is outweighed by the benefits of prefuzing. If not, the practice of prefuzing must be abolished or hazard control methods developed to reduce the risk to acceptable levels.

FOR THE COMMANDER:

ROBERT J. SHIROCK  
Safety Director

CF:  
FAASV WSM

## LIST OF ACRONYMS

ARV	Ammunition resupply vehicle
ASP	Ammunition supply point
ATP	Ammunition transfer point
CONUS	Continental United States
DP	Dual purpose
DSWS	Division Support Weapons System
FAASV	Field artillery ammunition support vehicle
HE	High explosive
ICM	Improved conventional munitions
LAP	Load, assemble, and pack
MLRS	Multiple Launch Rocket System
MOFA	Multi-option fuze artillery
MOS	Military operational specialty
OCONUS	Out of continental United States
PD	Point detonating
RDX	Cyclonite (hexahydro-trinitro-triazine)
SPH	Self-propelled howitzer
WP	White phosphorous

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